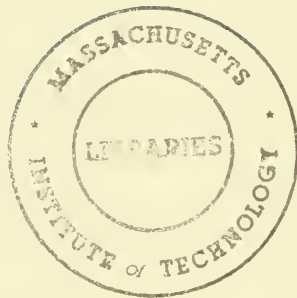


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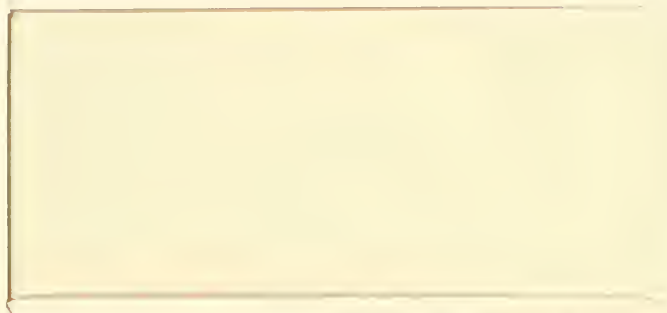
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A Longitudinal Study of the Effects of Boundary  
Spanning and Project Supervision on Turnover and  
Promotion in Research and Development

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WP# 1278-82  
January - 1982

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## Abstract

This research investigates the impact of supervisory boundary spanning activity on the turnover and promotion of professionals in a research and development laboratory. Using data collected at two points over a five year period, we find that after the initial stage of an individual's tenure, supervisory boundary spanning activity has no impact on either promotion or turnover. However, in the early stage of one's career, working for a supervisor who also was a gatekeeper significantly increased the probability of managerial promotion in development projects and decreased the probability of turnover for professionals throughout the laboratory. Gatekeepers serve an important socialization function in R & D over and above their information acquisition role. More generally, the results indicate that supervisory behavior directly affects early work experiences which, in turn, dramatically affect career outcomes.

What factors influence turnover and promotion in research and development settings? One research stream has looked at the impact of job experiences and formal supervision on turnover, performance and promotion (e.g., Berlew and Hall, 1966; Andrews and Farris, 1972), others have looked at norms and climate created in the laboratory (e.g., Pelz and Andrews, 1966; Barth and Vertinsky, 1975), while still others have looked at the impact of informal communication networks and boundary spanning roles (e.g., Allen, 1977; Tushman and Katz, 1980). This research focuses on formal and informal aspects of leadership by investigating the effects of supervisory boundary spanning on subordinate turnover and promotion. We build on research which indicates that turnover and promotion are affected by how well individuals are linked into an organization's formal and informal networks (Graen and Ginsburgh, 1977; Organ and Greene, 1972).

#### Literature Review and Hypotheses

Supervisory behavior is one important determinant in the making of an employee's organizational and professional career (Vicino and Bass, 1978; Thompson and Dalton, 1976; Kanter, 1977; Farris, 1972]. In R & D settings boundary spanning individuals are key actors in the Laboratory's informal communication networks (Tushman and Katz, 1980). This research investigates, over a five year period, the effects that boundary spanning supervisors have on their subordinates' careers in terms of turnover and managerial promotion. We first discuss the phenomenon of boundary spanning and then develop several hypotheses linking supervisory boundary spanning to subordinate turnover and managerial promotion.

To keep informed about relevant external developments as well as work requirements, project teams must gather and process information from a variety of outside sources. Such contact is especially critical for R & D project teams given their dependence on new technological advances within the larger professional community as well as their need for coordination with other organizational areas (Tushman and Katz, 1980; Tushman, 1977; Allen, 1977).

Although R & D groups must acquire external information, considerable research has shown that widespread direct contact by all project members is not an effective method for carrying out these external linkages. Instead, boundary spanning individuals evolve to effectively link their more local colleagues to external sources of information. Research by Allen (1977), Tushman and Katz (1980) and Tushman and Scanlan (1981 a,b) demonstrates that certain project members, labelled gatekeepers, link their colleagues with extra-organizational information sources, while other key individuals link their colleagues to different areas within the corporation (internal liaisons). Gatekeepers are those key individuals who are strongly connected to both internal colleagues as well as to professionals outside the organization; internal liaisons are strongly connected to internal colleagues as well as to other areas within the organization.

External information is transmitted effectively into project groups via a multi-step process. Boundary spanning individuals (that is, gatekeepers and internal liaisons) gather and understand relevant external (to the project team) information, and subsequently channel it in more meaningful terms to their more local colleagues. Boundary spanning individuals, then, perform an extremely valuable function, for they are the principal means by which external ideas and information are transferred into R & D project groups (Katz and Tushman, 1981).

Many boundary spanning individuals in R & D are also project supervisors, although formal supervisory status per se does not result in high communication

activity either within or across organizational boundaries. Rather, project supervisors who are seen as technically competent, who keep up-to-date, and who are seen as valuable sources of ideas and information are most likely to become boundary spanning individuals simply because they will be consulted and listened to more frequently on work related matters (Allen, 1977; Tushman and Scanlan, 1981 a, b; Rosen, Billings and Turney, 1976).<sup>1</sup>

While such linking-pin roles have been recognized as one of the more important elements of effective leadership and managerial behavior (e.g., Likert, 1967; Graen and Ginsburgh, 1977; Mintzberg, 1973), we still know very little about how boundary spanning activity relates to other important managerial functions. In addition to enhancing project effectiveness, would project supervisors fulfilling a boundary spanning role also be more likely to affect work activities and careers of those project members reporting to them?

#### Supervisory Boundary Spanning, Turnover and Promotion

Research over the past 15 years has demonstrated that interpersonal communications are the primary means by which engineering professionals acquire and disseminate important ideas and information (Menzel, 1966; Katz, 1981; Tushman and Nadler, 1981). Further, these informal social mechanisms are also the primary mechanism by which professionals learn the norms, values and operating rules of the organization (Kerr, 1977). Rather than relying on written technical reports, publications, hierarchy or other formal systems, professionals in R & D keep abreast of new developments and organizational demands through informal contact and personal associations with other R & D professionals (McCall, 1981).

If interpersonal contact and interaction are key determinants of integration and socialization in R & D, and if boundary spanning supervisors are key points in the laboratory's communication network, then it may be that they are doing much more than simply channeling outside information into their

groups. Most likely, boundary spanning supervisors assume a broader role within their work groups, becoming actively involved in the training, development, integration and socialization of their subordinates. Katz and Tushman (1981) found that gatekeeping supervisors not only gathered and disseminated external information, but they also facilitated the effective external interactions of their subordinates by helping to direct, coach and interpret their external contacts.

As a consequence of their extensive external linkages and their close working relationships with their subordinates, boundary spanning supervisors not only improve the performance of their group's technical efforts (Tushman and Katz, 1980), but they may also directly affect the personal development experiences of project members. To the extent that boundary spanning supervisors help project members participate and contribute more effectively within their work settings, be clear as to their work roles and their linkage to other corporate requirements, as well as keep project members well linked to external professional sources, project members are less likely to leave the organization (Graen and Ginsburgh, 1977; Pelz and Andrews, 1966; Porter and Steers, 1973). Further, the opportunity to work for boundary spanning supervisors may provide the individual with greater external exposure as well as more extensive work opportunities. Boundary spanning individuals are also highly influential in technical, administrative and personnel decision making (Tushman and Romanelli, 1981). If boundary spanning supervisors are influential and if they provide greater opportunities for their subordinates, then those individuals working for boundary spanning supervisors may have increased opportunities for promotion. The following hypotheses follow:

1. Project members working for boundary spanning supervisors are more likely to remain with the organization than project members working for supervisors who are not boundary spanners.
2. Project members working for boundary spanning supervisors are more likely to receive managerial promotions than project members working for supervisors who are not boundary spanners.

While these effects are proposed for project members in general, younger employees are especially likely to benefit from the socialization and developmental role played by boundary spanning supervisors (Berlew and Hall, 1966). Most turnover occurs within the early years of an engineer's work career, often within the first few years of organizational employment (Schein, 1978). Further, engineers usually expect managerial promotions associated with supervisory responsibilities usually between 35 and 40 (Dalton, Thompson and Price, 1981; Ritti, 1971). It is expected, then, that the hypotheses will be more relevant for younger project members. The hypotheses will, then, be tested for the full sample of professionals as well as for project members of different age groups.<sup>2</sup>

Project task characteristics. While the importance of boundary spanning has been well demonstrated (Allen, 1977), recent research indicates that not all R & D projects are alike in the way they function or in the way they should be managed (Tushman, 1977; Tushman and Katz, 1980; Allen, Tushman and Lee, 1979). Given differences in work requirements, there are substantial information processing differences faced by groups engaged in research, development or technical service kinds of activities.

In research work, project members are less constrained by local organizational circumstances since the nature of their work is universally defined. As a result, gatekeepers are not needed by research teams since individual members are able to communicate effectively with external colleagues (Katz and Tushman, 1979). Indeed, Tushman and Katz (1980) found that research teams relying on gatekeepers were significantly less effective than those research teams where individuals maintained their own external linkages. While research teams must also be linked to other organizational areas, evidence suggests that given the researcher's cosmopolitan orientation, supervisors are a more



effective way to insure organizational coordination (Allen et al., 1979).

Development projects involve more locally defined tasks in that their problems and solution strategies are defined and operationalized in terms of the organization's particular strengths, interests, language schemes and norms. Given uncertain technical requirements and the need for tight coupling with marketing and operations, development projects must be well linked to several distinct external areas. However, given the local orientation to complex, technologically uncertain tasks, communication across organizational boundaries becomes difficult for most development project members (Baker, Siegman and Rubenstein, 1967). Boundary spanning individuals are needed to effectively link development projects with external information areas within and outside the organization (Katz and Tushman, 1981).

Although technical service projects are also more local in nature, their work deals with more mature technologies and existing knowledge than development work (Rosenbloom and Wolek, 1970). With more stable technologies and problems that are more easily understood, members of technical service projects can rely on local procedures and precedent. Boundary spanning individuals are not critical in technical service areas since project members can be kept sufficiently informed about external events and information through formal mechanisms (Tushman and Katz, 1980).

Given these differences in work requirements, boundary spanning individuals will be more necessary and influential in development projects than in either research or technical service projects. If boundary spanning is particularly important in development projects, then the hypothesized effects of boundary spanning individuals on the careers of project subordinates should be accentuated in development projects. These ideas suggest the following hypothesis:

3. Project work characteristics will moderate the effects that boundary spanning supervisors have on the retention and promotion of subordinates.

The effects of boundary spanning supervisors will be greater for development projects than for either research or technical service projects.

Alternative comparisons. To what extent is promotion simply a function of working for a supervisor who was promoted to a higher managerial position? Webber (1976) has found that working for a highly promotable supervisor enhances one's own chance for promotion. Boundary spanning supervisors are usually promoted (Allen, 1977), but they comprise only a subset of supervisors who receive promotions over a given time frame. We will investigate whether there is any advantage for working with boundary spanning supervisors versus working for project supervisors who get promoted.

Finally, it is important to examine the effects of project performance on the careers of project members. It is possible that high project performance per se, rather than the interpersonal activities of boundary spanning supervisors, results in lower turnover and increased opportunities for promotion. Therefore, the hypotheses will be tested and compared against both the effects of working for supervisors who were promoted, and in working in high-performing projects.

## Methodology

### Setting

This study was conducted among all the R & D professionals of a large corporate R & D facility. At the start of our study, the laboratory's professionals (N = 325) were organized into seven separate functional departments which, in turn, were divided into a total of 61 projects. Each professional was asked to report his or her age and departmental tenure.

Five years after the initial data collection period, we returned to this R & D facility to ascertain which professionals were still employed by



the organization as well as their current laboratory positions. During this time interval, the R & D facility nearly doubled in size both in terms of personnel and in physical space. Despite this growth, our longitudinal examinations can only focus on the career histories of those professionals employed at the start of our study. In addition, eight percent of the laboratory's older professionals retired during the intervening five years and consequently have been excluded from all analytical investigations.

### Communications, Gatekeepers, and Internal Liaisons

To measure actual interpersonal communication, each professional was asked to report (on specially provided lists) those individuals with whom he or she had work-related oral communication on a randomly chosen day each week for 15 weeks. Sampling was constrained to provide equal representation of all weekdays. Respondents reported all personal contacts both within and outside the organization, including whom they talked to and how many times they talked to that person during the day. They did not report communications which were strictly social, nor did they report written communication. During the 15 weeks, the overall response rate was 93 percent. Moreover, 68 percent of all communication interactions within the R & D organization were reciprocally reported by both parties. These research procedures are similar to those used in other sociometric communication studies such as Allen and Cohen (1969), Whitley and Frost (1973), and Tushman and Scanlan (1981a,b) and provide a clear, accurate picture of each professional's communication patterns.

For this study, six mutually exclusive communication measures were operationalized for each project subordinate as follows:

1. Departmental Communication: The amount of communication reported between each project member and other non-supervisory professional colleagues within his or her functional department including one's project colleagues.

2. Laboratory Communications: The amount of communication reported between each professional member and other professional colleagues within the remaining six functional departments.
3. Immediate Supervisory Communication: The amount of communication reported between each project member and his or her immediate project supervisor.
4. Departmental Supervisory Communication: The amount of communication between the project member and his or her departmental supervisor.
5. Corporate Communication: The amount of communication reported by each project member with other individuals outside the R & D laboratory but within other corporate divisions, primarily marketing and manufacturing.
6. External Professional Communication: The amount of communication reported by each project member with other R & D professionals outside the parent organization, including professionals within universities, consulting firms, and various professional societies.

For each project subordinate, the amounts of communication with these two horizontal, two vertical, and two outside sources of information were calculated by summing the number of interactions reported during the 15 weeks (see Katz and Tushman, 1979 for details). Although the overall response rate was extremely high, raw communication data for incomplete respondents were proportionately adjusted by the number of missing weeks. Furthermore, all six measures are appropriately normalized to report communication on a monthly basis. As shown by Table 1, the six measures of communication were not strongly associated with one another except for the high positive correlation between departmental and immediate supervisory communication ( $r = .34$ ).

Conceptually, gatekeepers are defined as those project members who are high internal communicators and who also maintain high external linkages with outside professionals. This study operationalized gatekeepers as those project members whose intradepartmental and external professional communications were both in the top fifth of their respective distributions (see also Whitley and Frost, 1973). Internal liaisons, on the other hand, are defined as those project members who were in the top fifth of their intra-departmental

communication distribution and who also ranked in the top fifth of their communications to other functional departments and organizational divisions (Allen and Cohen, 1969; Tushman, 1977, Tushman and Scanlan, 1981 b). Using these definitions, 18 percent (n=11) of the project supervisors functioned only as internal liaisons, 13 percent (n=8) functioned only as gatekeeping supervisors, and 11.5 percent (n=7) fulfilled both the gatekeeping and internal liaison roles.

Insert Table 1 about here

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### Project Characteristics

As discussed by Rosenbloom and Wolek (1970) and Tushman (1977), R & D project tasks differ widely with respect to the generation of new knowledge vs. the utilization of existing knowledge and experience. Based on this dimension, distinct project categories have been designed around research, development, and technical service kinds of project activities. Using the definitions described by Katz and Tushman (1979), respondents were asked to indicate how well each category represented the objectives of their project work. As in Pelz and Andrews (1966), respondents were also asked to indicate what percentage of their project activities fell into each of the possible project categories. A weighted average of the answers to these two questions was calculated for each respondent (Spearman-Brown reliability = 0.91).

To categorize projects empirically, however, the homogeneity of members' perceptions of their project characteristics was also checked to ensure the appropriateness of aggregating across individual project members (for more details, see Tushman, 1977). As pooling was appropriate, individual responses after averaging yielded 14 Research, 23 Development, and 23 Technical Service Projects.

## Project Performance

To get comparable measures of project performance across significantly different technologies, all departmental and laboratory managers ( $N = 9$ ) were individually interviewed and asked to evaluate the overall technical performance of all projects with which they were technically familiar. If they could not make an informal judgement for any particular project, they were asked not to rate the project. Based on these judgements, the performance of each project team was independently evaluated by an average of five managers using a seven-point Likert type scale ranging from (1) very low to (5) very high. These individual ratings were subsequently averaged to yield overall project performance scores (Spearman-Brown reliability = 0.81). To classify project members according to whether they were working in a high or low performing project team, project groups were split at the sample mean of 4.59.

## Promotion and Turnover

Almost five years after the collection of the preceding data, we returned to this R & D organization to gather data on managerial promotions and turnover. Despite the growth in technical effort and personnel, 31 percent of the project members and 19 percent of the project supervisors decided to leave the company during this time interval. Furthermore, among the 15 gatekeeping and 18 internal liaison supervisors, the turnover rates were 20 and 17 percent, respectively.

In this organization, managerial positions and titles start within the department above the project supervisory level. Over the five year interim period, 11 percent of the original project members and 46.5 percent of the original project supervisors attained such managerial positions. Finally,

while almost half of the initial group of project supervisors had received managerial promotions, 73.3 percent of the gatekeeping subset and 67 percent of the internal liaison subset were promoted managerially.

## Results

### Turnover

To test the first hypothesis regarding the influence of boundary supervisors on the turnover rates of project engineers, Table 2 reports the retention percentages of project members as a function of their prior type of supervision. For the sample as a whole, there are strong differential effects of prior supervisory boundary spanning and subsequent turnover. Those individuals who reported to gatekeeping supervisors were significantly less likely to leave the organization after five years than those who reported to supervisors who were either non-boundary spanners or only internal liaisons. Those individuals who reported to internal liaisons had the lowest retention rate (62 percent), while those who reported to supervisors who were both gatekeepers and internal liaisons had the highest retention rate (85 percent). Evidently, gatekeepers have a strong impact on retention rates while internal liaisons do not. Individuals who worked for supervisors who were subsequently promoted were no more likely to remain with the laboratory than were individuals who worked for supervisors who were not promoted (Table 2B). Similarly, individuals who worked in high performing projects were no more likely to remain in the organization than individuals working in low performing projects (Table 2C).

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Insert Table 2 about here  
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Since 70 percent of employee turnover occurred for individuals who were

less than 36, additional comparisons were made for project members at different age groupings. Except in the case of supervisors who were also gatekeepers, these additional comparisons failed to uncover any significant turnover differences between prior types of reporting relationships or high and low project performance. To pinpoint the influence of supervisory gatekeepers on subordinate turnover, Figure 1 plots the cumulative retention rates between project members reporting to gatekeeping supervisors (Group A) and those members not reporting to gatekeeping supervisors (Group B) as a function of age.<sup>3</sup>

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Insert Figure 1 about here  
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Of those project subordinates who were 25 years or less, only 33 percent remained in the organization if they were not reporting to a gatekeeping supervisor while the comparable percentage for project members assigned to a gatekeeping supervisor was almost 80 percent. Similarly, of those project subordinates who were 35 years old or less, only 57 percent remained with the organization if they had not been working with a gatekeeping supervisor while the comparable percentage for those in Group A was 84 percent. While this difference is also significant statistically, it is clear from the disparities between Groups A and B that most of this difference comes from the turnover of members in the lower ages of 25 through 29. Retention rates between the two groups converge rather quickly after age 35.

In examining the differences in Figure 1, there appear to be at least three distinct age breaks: (1) less than 30; (2) 30-35; and (3) 36 or more. By categorizing project subordinates according to these age breaks, Table 3 clearly shows that project subordinates less than 30 years of age were significantly more likely to remain in the organization if they had been working with



and reporting to a gatekeeping supervisor. Over 84 percent of such members were still with the organization after five years versus only 51 percent for the parallel group of young engineers not reporting to gatekeeping supervisors. Similar significant differences in turnover, however, did not emerge between project members for each of the two remaining age categories.

Not all gatekeepers are project supervisors. In this sample, there were five project teams in which one of the project members, not the project supervisor, functioned as a gatekeeper. While the number of cases is very small, the turnover pattern of engineers in groups with a non-supervisory gatekeeper was very similar to the turnover pattern of engineers in projects without any gatekeeper. For project members less than 35 years of age, for example, the retention rate in projects without gatekeepers over the next five years was 56 percent while the comparable retention rate in projects with a non-supervisory gatekeeper was also relatively low, only 58 percent. Remember that the retention rate with gatekeeping supervisors was significantly higher at 84 percent. It may be that while collegial gatekeepers are important in the area of technology transfer, they do not have the same positive effects as gatekeeping supervisors with respect to socialization and developmental processes.

These results indicate that there are significant differences in the impact of boundary spanning supervisors on subordinate turnover. Individuals reporting to gatekeeping supervisors were significantly more likely to remain with the organization after 5 years than those individuals who did not report to gatekeeping supervisors. These effects do not hold across age groups. The influence of gatekeeping supervisors on the retention of laboratory personnel is accentuated for younger employees and disappears for those older and more experienced individuals. Supervisors who were also internal liaisons had no impact on subordinate turnover.

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Insert Table 3 about here  
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While gatekeeping supervisors appear to influence the turnover of project subordinates in general, hypothesis three suggested that these effects might be stronger for members of development project groups. To examine this possibility, Table 4 compares the turnover rates of project engineers less than 30 years of age for each project category. The turnover differences between project subordinates with and without gatekeeping supervisors was substantially positive for each project area. While the small number of cases precludes statistical comparisons, what is important is the overall consistent pattern of differences. In each project area approximately half of the youngest project members not reporting to gatekeeping supervisors had left the organization within five years despite the substantial growth within the R & D facility. The corresponding turnover rates for those individuals reporting to gatekeeping supervisors did not exceed 25 percent.

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Insert Table 4 about here  
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Gatekeeping supervisors have a strong effect on turnover rates of young professionals across this laboratory. What is it about gatekeeping supervisors that generates these turnover patterns? It may be that turnover is partially a function of how well the young professional gets integrated into the laboratory's informal networks. Since gatekeepers are key individuals in a laboratory's communication network, reporting to a gatekeeping supervisor may well facilitate the young professional's linkage to both internal and external sources of information. To investigate whether younger project members reporting to gatekeeping supervisors had different interaction patterns than project members reporting to non-gatekeeping supervisors, Table 5 reports mean communication scores broken down by supervisory relationship and turnover.



Separate comparisons are reported for communication to each of six information areas.

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Insert Table 5 about here  
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As shown in Table 5, there were no differences between the communication patterns of individuals working for supervisory gatekeepers and those working for non-gatekeeping supervisors. The overall levels of communication are very similar for all six communication measures. Furthermore, regardless of their supervisory reporting relationship, project members who either stayed or left did not differ in the intensity of their prior horizontal collegial contacts or in their contacts with individuals outside their laboratory. What differentiated stayers from leavers was the amount of contact with both project and departmental supervisors; that is, their degree of vertical communication and integration. For both gatekeeping and non-gatekeeping relationships, project subordinates who stayed over the five years had significantly more communication with their departmental supervisor than project members who left. Stayers also had more interaction with their project supervisors, although the difference was not quite significant in the case of individuals reporting to non-gatekeeping project supervisors.

What are the relative effects of prior communication patterns and reporting relationships on subsequent turnover? A hierarchical discriminant analysis was run on the turnover outcomes of the 62 project members less than 30 years of age using the six communication measures and the reporting relationship (coded 1 for working for a gatekeeping supervisor and 0 for other reporting relationships) as possible differentiating variables.

After both measures of vertical communications entered the discriminant analysis significantly, none of the remaining independent variables, including

reporting to a gatekeeping supervisor, could account for any significant amount of additional discrimination between stayers and leavers. Using the Wilks Lambda criterion, the overall discriminant function containing both vertical communication variables was significant at the  $p < .05$  level ( $x^2 = 6.13$ ;  $DF = 2$ ) and correctly classified 74 percent of the project subordinates.<sup>4</sup> Thus, it may not be the assignment of young project members to a gatekeeping supervisor per se than enhances long-term retention. What really makes the difference may be the high level of vertical interaction that takes place with gatekeeping supervisors but which can also take place with other project supervisors.

#### Managerial Promotion

During the five year interim period, eleven percent, or 23 of the project members were promoted to managerial positions in the laboratory. Table 6 reports promotion percentages for different types of prior reporting relationships. Those individuals reporting to supervisors who were also gatekeepers were significantly more likely to be promoted than those individuals reporting only to internal liaisons or non-boundary spanning supervisors. As with the turnover results, gatekeepers have a strong impact on promotion patterns while internal liaisons do not. Individuals who worked for supervisors who were subsequently promoted were no more likely to be promoted than were individuals who worked for supervisors who were not promoted. Similarly, individuals who worked in high performing projects were no more likely to get promoted than individuals who worked in low performing projects.

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Insert Table 6 about here  
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Almost 70 percent of the individuals subsequently promoted to managerial

position were between the ages of 27 and 32. The others were uniformly distributed between the ages of 35 through 52. Such a clustered distribution suggests that a normal or expected career progression exists within this organization. Since the vast majority of managerial promotions were awarded to project members who were between 27 and 32 years old at the start of our study, we reexamined the influence of prior reporting relationships on the managerial promotions of all project members within this more limited age range. As before, the different types of reporting relationships showed no significant effects on the promotional rates of project subordinates within this restricted subsample except for the comparison of gatekeeping versus non-gatekeeping supervisors. For this comparison, the difference was significant; for project members reporting to gatekeeping supervisors, the promotional rate was 41.2 percent, whereas only 17.4 percent of the engineers reporting to non-gatekeeping supervisors were similarly promoted.

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 Insert Table 7 about here  
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While proportionately more engineers reporting to gatekeeping supervisors were managerially promoted within the general subsample, Table 7 also clearly shows that most of the difference comes from project members who were working in the area of product and process development. There was no significant difference in the promotional rates of project engineers reporting to gatekeepers in either research or technical service areas. On the other hand, two-thirds of the engineers reporting to gatekeepers in development projects received managerial promotions in contrast to only 18.5 percent of engineers reporting to non-gatekeepers, although once again the number of cases is rather small. Nevertheless, development work is precisely the project area in which

gatekeepers are presumably most necessary and influential, and where they were hypothesized to have the strongest influence over managerial promotions.

As in the turnover analyses, we examined the communication patterns of project members within the 27-32 year old age range to see if those promoted also had differential patterns of contacts and interactions within their work settings. None of the communication measures, however, was significantly related to managerial promotions for these individuals.

### Discussion

This research emphasizes the important influence that project supervisors can have on the careers of their subordinates. Not all supervisors were equally influential. Only supervisors who were also gatekeepers significantly reduced the probability of subordinate turnover across task areas and increased the probability of managerial promotion in development projects. Those supervisors who were not also gatekeepers had no systematic effect on employee turnover and promotion. As predicted, the effects of gatekeeping supervisors was only found for younger employees. These results are discussed in greater detail below.

Project supervisors who were also gatekeepers increased significantly the likelihood that young engineers would remain employed within their organization over a five year period. While previous research has focused almost exclusively on the important role that gatekeepers play in the effective transfer of outside technology into their project groups, these findings strongly suggest that gatekeepers play an even larger role within their project teams. Given the significantly higher retention rate for younger project members, it is likely that gatekeeping supervisors assume a more active role in helping young engineers become established and integrated during their early

career years.

Gatekeeping supervisors appear especially adept at providing the kind of work environment that helps keep young professionals from leaving--more so than other kinds of project supervisors. In fact, project supervisors who were internal communication stars or organization liaisons, or who were eventually promoted managerially were not at all effective in reducing the turnover rate of young engineers. Nor was the assignment of young engineers to higher performing project groups related to lower turnover. On the other hand, gatekeeping supervisors had consistently lower rates of turnover among young engineers in all three project areas including research, development, and technical service. This influence emerged in each task area despite the fact that the gatekeeping role has been found to be most appropriate in development activities.

What is it about these gatekeepers that is so effective in alleviating high turnover? Is it their supervisory status, their high technical competence and ability, or their external linkages that allows them to affect turnover? While these characteristics are certainly helpful, the communication results suggest that gatekeepers are likely to affect the turnover of their young project subordinates through facilitating high levels of hierarchical interaction and activity. Since gatekeeping supervisors are highly communicative and interpersonally active, they usually have significantly more contact and involvement with their project subordinates than other supervisors. It is these high levels of hierarchical communication that were found to discriminate between young engineers who stayed and those who left. Thus, it may not be the gatekeeping role or supervisory status per se that influences turnover. Consistent with Graen and Ginsburgh (1977), what may be important are the levels of vertical

activity and involvement with relevant supervisors which can be fostered by any project supervisor but which are most likely to be found with gatekeeping supervisors.

In addition to lessening the turnover of their younger project members, gatekeeping supervisors also seem to influence the managerial promotions of their project subordinates during the career stage in which such promotions are usually expected to take place. Over the five year interval, almost 70 percent of the project members promoted to managerial positions were between the ages of 27 and 32 at the start of our study. Within this bounded age interval, project members working for gatekeeping supervisors were proportionately more likely to receive these promotions than project members not working for gatekeeping supervisors.

These differences in promotion patterns were not found across the laboratory. It was hypothesized that since gatekeepers are most important for enhancing project performance in development groups, that supervisory gatekeepers would have the greatest impact on managerial promotions in these areas and less on influence on promotions in research or technical service areas. The promotional rate for project members reporting to gatekeepers in development areas was more than three times the promotional rate of project members assigned to non-gatekeeping supervisors. In contrast, there was no clear added advantage in terms of managerial promotion in working for gatekeeping supervisors within research or technical service areas. Working for a gatekeeping supervisor in development projects is not only associated with more rapid laboratory integration but may also be associated with access to organizationally critical information. Gatekeepers in development projects are also highly influential individuals (Tushman and Romanelli, 1981; Tushman and Katz, 1980). Access to scarce information along with working for influential



supervisors may be associated with greater organizational visibility, more work opportunities and, in turn, higher promotion rates.

Finally, none of the other types of prior reporting relationships (including internal liaisons), supervisory promotions, or high and low project performance, were found to influence the managerial promotional rates of project members. Boundary spanning gatekeeping supervisors, then, play a particularly important role within R & D settings. They are not only essential in keeping their development project teams up-to-date, but they also exert great influence over the eventual retention and promotions of project engineers.

From a broader perspective, these findings emphasize some very important aspects of project leadership. The ability of gatekeepers to influence turnover through high interpersonal activity emphasizes the important role that project supervisors can and should play during the early socialization years of young professionals. As discussed by Van Maanen (1977) and Katz (1980), young employees and newcomers build perceptions of their work environment and establish their own role identities through processes involving interpersonal relationships and interactions. Perceptions and behaviors are significantly shaped and influenced by the many different kinds of contacts and communications that take place early in one's career. Young engineers, therefore, not only need to interact with their colleagues and peers, but they also require considerable interaction with and feedback from relevant supervisors to learn what is expected of them and to decipher how to be a high performing contributor within the work setting.

Because of their high level of interpersonal activity, gatekeepers seem to meet these breaking-in concerns more often than other project supervisors. While the technology transfer aspects of

the gatekeeping function may be most appropriate in development work, the need for high levels of communication and guidance between young professionals and their supervisors is important for all work areas. It is for this reason that gatekeeping supervisors were consistently influential in reducing the turnover rates of young engineers in all project areas and not just in product/process development work. Most likely, such interpersonal activity not only facilitates socialization but also results in more realistic expectations, perceptions and understanding about one's role in the project and with the larger organization--all of which are important in decreasing the turnover of newcomers (Schein, 1978; Wanous, 1980; Pondy, 1978).

While gatekeeping supervisors had an important impact on turnover and promotion patterns of younger employees, they did not affect career outcomes of older employees. Those individuals in the innovation or maintenance phases of their careers will have a more clearly developed sense of organizational identity and their reputations will be more firmly developed (Katz, 1980). The turnover and promotion rates of these veterans will be influenced more by individual differences and by task and organizational factors than by the characteristics of their immediate supervisor.

### Implications and Conclusion

Turnover is an expensive organizational problem (Cawsey and Wedley, 1979). The effects of turnover are accentuated in technology based settings where there is increased dependence on, yet a relatively scarce supply of, well trained scientists and engineers. While much of the turnover research investigates relatively short time intervals (e.g., Wanous, 1980; Krackardt et al., 1981), these results suggest that one can affect the turnover of young scientists and engineers over a long period of time. Our results build on other



research (e.g., Graen and Ginsburgh, 1977; Dalton et al., 1981; Pelz and Andrews, 1966) which indicates that in the early stages of an employee's career, getting linked into organizational information networks and learning the organization's customs and norms are vital.

While early socialization can take place in a number of ways, our results indicate that supervisors who are also gatekeepers are particularly effective in the early socialization of their subordinates. Gatekeeping supervisors seem to be uniquely able to deal with the more professional orientation of young engineers and scientists, and help them understand and interpret the reality of their new setting and thereby help them to function more fully and meaningfully within the organization. Further, in development projects, where gatekeepers are particularly important, those individuals who worked for gatekeeping supervisors had a greater probability of being promoted. Our results, then, strongly indicate that working for gatekeeping supervisors facilitates relatively rapid integration into internal and external communication networks which is, in turn, associated with reduced probability of leaving the organization and greater opportunities for promotion. These results were not found for those supervisors who also were organizational liaisons or those who were internal communication stars.

Gatekeepers are particularly important in the acquisition and transfer of scientific and technological information in the firm (Tushman, 1977; Katz and Tushman, 1979; Allen, 1977), and are influential actors in technical and administrative decision making (Tushman and Romanelli, 1981). These results and those reported by Katz and Tushman (1981) indicate that well beyond information transfer and decision making functions, gatekeepers serve an important socialization and training function for younger members of the laboratory. Gatekeeping supervisors operate as effective socializing agents and

network builders for young scientists and engineers across task areas.

Gatekeepers are, therefore, vital resources in R & D settings. Laboratory managers must be able to facilitate their development and promotion. Potential gatekeepers must be encouraged and given opportunities to develop their internal and external linkages; they must be recognized and rewarded for their contributions. Once promoted, supervisory gatekeepers must be given the opportunity and be encouraged to retain and further develop their internal and external networks. Those gatekeepers who are promoted and get too distant from the technical staff may lose their ability to disseminate external information and to be an effective socialization agent. Beyond the management of gatekeepers over time, our results also indicate that more promising young engineers and scientists should be assigned to gatekeeping supervisors. By managing the job assignments of young engineers so they gain exposure to gatekeeping supervisors, the laboratory will be more likely to reduce turnover levels of these key resources.

The development and evolution of gatekeepers is particularly important in development areas of the laboratory. In these areas gatekeepers are not only important in terms of socialization and information flow, but their existence and distribution will strongly influence the kind of leadership and direction pursued. If gatekeeping supervisors enhance the managerial promotions of project members, then much of the future leadership within the laboratory will depend not only on who gets to work for these key individuals by certain career stages, but also on which of the key technologies are covered by such individuals. The degree to which certain technologies and consequently certain products or processes are emphasized within an R & D laboratory may strongly depend on the particular kinds of gatekeepers that are present to influence decisions within the setting.

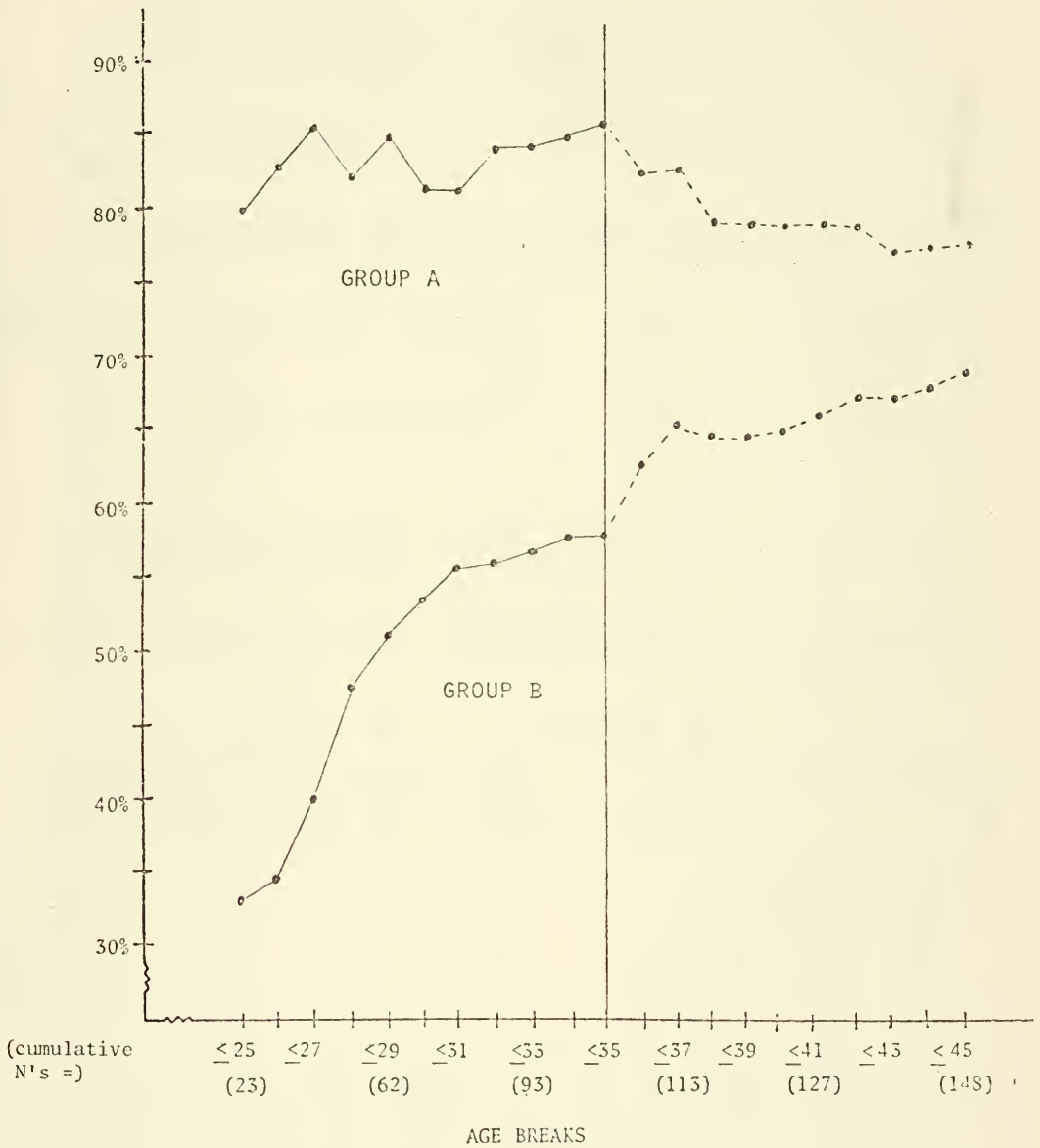
Finally, one should realize that in a longitudinal field study of this sort, the random assignment of project members to gatekeeping and non-gatekeeping supervisors was not possible. While our discussions and explanations emphasize the active role of gatekeepers in influencing the careers of project members, it is possible that gatekeepers either attracted or were assigned members who were more likely to stay or who were of higher promotional potential than those project members working for non-gatekeeping supervisors. These issues, the generality of these findings to other settings and the broadening of our understanding of gatekeepers, turnover and promotion await future research. Even with this traditional caveat, substantial research and practice strongly indicates that gatekeepers are vital in R & D settings. Our results continue this line of research and strongly indicate that the careers of young engineers and scientists are enhanced by their exposure to gatekeeping supervisors. Gatekeepers should be managed over time and seen not only as an important information source, but also as an important resource in developing young scientists and engineers.

## FOOTNOTES

1. While research has shown that between 70 and 80 percent of the gatekeepers are also first level project supervisors, most project supervisors are not gatekeepers (Allen, 1977; Tushman and Katz, 1980). In fact, only 20 to 40 percent of the project supervisors are usually performing a technical gatekeeping function.
2. In examining these hypotheses, age really serves as a surrogate for examining employees at similar career stages. Strictly speaking, several cohorts of employees at different career stages would be the most advantageous method for testing the influence of gatekeepers on project subordinates. In a field study of this sort, however, such cohorts are unavailable. Furthermore, there are simply not enough turnover cases, especially with gatekeeping supervisors, to even begin to determine whether age, tenure, or some other career variable is most appropriate. In any event, age and tenure are so highly associated for very young employees that any distinction would be primarily conceptual rather than empirical.
3. Group A, then, includes supervisors who were either gatekeepers or who were simultaneously functioning as gatekeepers and internal liaisons. Group B includes the remaining project supervisors, i.e., non-boundary spanning and internal liaison supervisors.
4. One should point out that multivariate tests, including discriminant analyses, are very misleading when the distribution of respondents differs substantially across the two coded categories. It is for this reason that individual analyses are conducted initially followed by the discriminant summary rather than simply relying on multivariate tests per se.

Figure 1. Retention of Engineers After 5 Years By Type of Reporting Relationship at Successive Age Breaks

Percent of Staff Engineers Remaining With Organization After 5 Years



LEGEND

- Group A: Staff engineers who reported directly to a gatekeeping supervisor.  
 Group B: Staff engineers who reported directly to a non-gatekeeping supervisor.

Note: a) The vertical line indicates that pairwise percentages between Groups A and B remained significantly different ( $p < .05$ ) through an age break of 35 years.

b) N's represent the total number of engineers within both Groups at six representative age breaks.

Table 1. Variable Statistics and Intercorrelations

Variables	1	2	3	4	5	6	7	8	9	10
<u>Communications (per month) With:</u>										
1. Departmental colleagues	1.00									
2. Laboratory colleagues	.10	1.00								
3. Immediate supervisor	.34	.09	1.00							
4. Group supervisor	.20	.19	.15	1.00						
5. Corporate areas	.14	.02	.13	.10	1.00					
6. External professionals	.11	.11	.16	-.01	.15	1.00				
<u>Other Variables</u>										
7. Age (yrs.)		-.14	.05	-.15	-.06	.08	-.07	1.00		
8. Departmental tenure (yrs.)		.01	.08	-.04	-.08	.07	-.02	.47	1.00	
9. Turnover		.02	-.02	-.08	-.17	-.02	.05	-.31	-.27	1.00
10. Managerial promotion		.08	.05	.03	.06	.03	.04	-.20	-.16	-.04
Means =	112.8	24.1	22.6	2.9	21.3	1.3	36.5	4.0	4.0	4.0

N = 218; with an N of this order, a correlation of .18 is significant at the p < .01-level. Turnover was coded with 0 and 1 to denote engineers who remained or left, respectively. Managerial promotion was also coded 0 and 1 to denote engineers not promoted to this level versus those who were.

Table 2

Supervisory Influence on the Proportion of Engineers Remaining  
in the Organization Over a 5-Year Period

A. Prior Type of Reporting Relationship: Engineer worked for a supervisor who was:

	<u>Internal Liaison</u>	<u>Gatekeeper</u>	<u>Gatekeeper and Internal Liaison</u>	<u>Neither a Liaison nor a Gatekeeper</u>
% Remaining in Organiza- tion after 5 Years	62% <sup>b</sup>	82% <sup>a</sup>	85% <sup>a</sup>	70% <sup>b</sup>
(N)	(45)	(28)	(20)	(115)

Percentages with superscript "a" are significantly greater than percentages with superscript "b" at the .10 level or less.

B. Did Engineer Work for a Supervisor who  
was Subsequently Promoted to a Manager-  
ial Position?

	<u>Yes</u>	<u>No</u>
% Remaining in Organiza- tion after 5 Years	67.6	71.7
(N)	(102)	(106)
	not significantly different	

C. Did Engineer Work in a Project  
that was:

	<u>High Performing</u>	<u>Low Performing</u>
% Remaining in Organiza- tion after 5 Years	73.7	63.5
(N)	(114)	(104)

not significantly different

Table 3. Proportion of Engineers Remaining in the Organization After 5 Years By Prior Age and Reporting Relationship

-----Prior Reporting Relationship-----			
Prior Age of Engineers	Assigned to a Gatekeeping Supervisor	Not Assigned to a Gatekeeping Supervisor	Proportional Differences
a) Less than 30	84.6% (n=13)	51.0% (n=49)	33.6**
b) Between 30 & 35	83.3% (n=12)	66.7% (n=27)	16.6
c) Greater than 35	79.2% (n=24)	78.3% (n=83)	0.9

Note: Significant proportional differences are indicated as follows:  
 (\*p < .10; \*\* p < .05).



Table 4. Proportion of Young Engineers (<30) Remaining in the Organization After 5 Years By Prior Reporting Relationship and Project Task Areas

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-----Prior Reporting Relationship-----

Prior Project Areas	Assigned to a Gatekeeping Supervisor	Not Assigned to a Gatekeeping Supervisor	Proportional Differences
a) Applied Research	83.3% (n=6)	44.4% (n=9)	38.9
b) Product/Process Development	75.0% (n=4)	53.8% (n=26)	21.2
c) Technical Service	100.0% (n=3)	50.0% (n=14)	50.0

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Note: Because of small sample sizes, statistical tests are not used; instead the focus is on the overall consistent pattern of proportional differences.

Table 5. Mean Communications of Young Engineers (< 30 years) Broken Down by Prior Reporting Relationship and Subsequent Turnover

Prior Measures of Communication (per month)	-----Prior Reporting Relationship-----	
	Assigned to a Gatekeeping Supervisor	Not Assigned to a Gatekeeping Supervisor
<u>Horizontal Communications With:</u>		
1. Departmental Colleagues		
a. Engineers Who Remained	117.8	104.8
b. Engineers Who Left	110.2	113.4
2. Laboratory Colleagues		
a. Engineers Who Remained	28.2	26.3
b. Engineers Who Left	27.1	24.8
<u>Vertical Communications With:</u>		
3. Immediate Supervisor		
a. Engineers Who Remained	30.1 <sup>a</sup>	27.6
b. Engineers Who Left	8.8 <sup>b</sup>	19.0
4. Departmental Supervisor		
a. Engineers Who Remained	4.9 <sup>a</sup>	3.6 <sup>a</sup>
b. Engineers Who Left	0.0 <sup>b</sup>	1.2 <sup>b</sup>
<u>Outside Communications With:</u>		
5. Other Corporate Areas		
a. Engineers Who Remained	17.9	20.8
b. Engineers Who Left	25.8	17.4
6. External Professionals		
a. Engineers Who Remained	1.1	2.1
b. Engineers Who Left	5.8	2.0

Note: Communication means with superscript "a" are significantly greater than communication means with superscript "b" at the .05 level or less. N's can be derived from percentages in Table 3.

Table 6

Supervisory Influence on the Proportion of Engineers Promoted to Managerial Level Positions over a 5-Year Period

A. Prior Type of Reporting Relationship: Engineer worked for a supervisor who was:

	<u>Internal Liaison</u>	<u>Gatekeeper</u>	<u>Gatekeeper and Internal Liaison</u>	<u>Neither a Liaison nor a Gatekeeper</u>
% Promoted to Managerial Positions after 5 Years	11.1% <sup>b</sup>	14.3% <sup>a</sup>	15% <sup>a</sup>	11.3% <sup>b</sup>

Percentages with superscript "a" are significantly greater than percentages with superscript "b" at the .10 level or less.

B. Did Engineer Work for a Supervisor who was Subsequently Promoted to a Managerial Position?

C. Did Engineer Work in a Project that was:

	<u>Yes</u>	<u>No</u>	<u>High Performing</u>	<u>Low Performing</u>
% Promoted to Managerial Positions after 5 Years	11.8%	10.4%	9.6%	12.5%

Neither differences between proportions are significantly different

Note: See Table 2 for N's.

Table 7. Proportion of Engineers Promoted to High Level Managerial Positions Over the Next 5 Years By Prior Reporting Relationship and Project Task Areas<sup>a</sup>

-----Prior Reporting Relationship-----			
Prior Project Area	Assigned to a Gatekeeping Supervisor	Not Assigned to a Gatekeeping Supervisor	Proportional Differences
Across All Areas	41.2% (n=17)	17.4% (n=46)	23.8*
<u>By Project Area:</u>			
a) Applied Research	33.3% (n=6)	20.0% (n=10)	13.3
b) Product/Process Development	66.7% (n=6)	18.5% (n=27)	48.2**
c) Technical Support	20.0% (n=5)	11.1% (n=9)	8.9

<sup>a</sup>Table includes only those engineers in the age range (27 through 32) in which almost 70% of the promotions took place. Significant proportional differences are indicated as follows: (\*p < .10; \*\*p < .05).

- Allen, T. J. Managing the Flow of Technology. Cambridge: MIT Press, 1977.
- Allen, T. J. and Cohen, S. "Information flow in R & D labs." Administrative Science Quarterly, 1969, 14, 12-19.
- Allen, T. J., Tushman, M. and Lee, D. "Technology transfer as a function of position on research, development, and technical service continuum." Academy of Management Journal, 1979, 22, 694-708.
- Andrews, F. and Farris, G. "Supervisory practices and innovation in scientific teams." Personnel Psychology, 1967, 20, 497-515.
- Baker, N., Siegmann, J. and Rubenstein, A. "Effects of perceived needs on the generation of ideas in R & D projects." IEEE Transactions on Engineering Management, 1967, 14, 156-163.
- Barth, R. and Vertinsky, I. "The effect of goal orientation and information environment in research performance." Organizational Behavior and Human Performance, 1975, 13, 110-132.
- Berlew, D. and Hall, T. "The socialization of managers: effects of expectations on performance." Administrative Science Quarterly, 1966, 11, 207-223.
- Cawsey, T. and Wedley, W. "Labor turnover costs: measurement and control." Personnel Journal, 1979, 58, 90-95.
- Coleman, J., Katz, D., and Menzel, I. Diffusion of Innovation. New York: Free Press, 1966.
- Dalton, G., Thompson, P., and Price, R. "The four stages of professional careers: A new look at performance by professionals." In R. Katz (Ed.), Career Issues in Human Resource Management. Englewood Cliffs, N.J.: Prentice-Hall, 1981, 129-153.
- Dewhirst, H. D., Arvey, R. D., and Brown, E. M. "Satisfaction and performance in research and development tasks as related to information accessibility." IEEE Transactions on Engineering Management, 1978, 25, 58-63.
- Farris, G. "The effect of individual roles on performance in innovative groups." R & D Management, 1972, 3, 23-28.
- Graen, G. and Ginsburgh, S. "Job resignation as a function of role orientation and leader acceptance." Organizational Behavior and Human Performance, 1977, 19, 1-17.
- Graen, G., Cashman, J., Ginsburgh, S., and Schiemann, W. "Effects of linking-pin quality on the quality of working life of lower participants." Administrative Science Quarterly, 1977, 22, 491-504.
- Hagstrom, W. The Scientific Community. New York: Basic Books, 1965.
- Kanter, R. M. Work and Family in the United States. New York: Russell Sage, 1977.

Katz, R. "Time and work: Toward an integrative perspective." In B. Staw and L. L. Cummings (Eds.), Research in Organizational Behavior, 1980, 2, JAI Press, 81-127.

Katz, R. "Managing careers: The influence of job and group longevities," In R. Katz (Ed.), Career Issues in Human Resource Management. Englewood Cliffs, N.J.: Prentice-Hall, 1981, 154-181.

Katz, R. and Tushman M. "Communication patterns, project performance and task characteristics: An empirical evaluation and integration in an R & D setting." Organizational Behavior and Human Performance, 1979, 23, 139-162.

Katz, R. and Tushman, M. "An investigation into the managerial roles and career paths of gatekeepers and project supervisors in a major R & D facility." R & D Management, 1981, 11, 103-110.

Kerr, S. "Substitutes for leadership: Some implications for organizational design." Organization and Administrative Sciences, 1977, 2, 135-146.

Krackhardt, D., McKenna, J., Porter, L., and Steers, R. "Supervisory behavior and employee turnover: A field experiment." Academy of Management Journal, 1981, 24, 249-259.

Likert, R. The Human Organization. New York: McGraw-Hill, 1967.

McCall, M. "Leadership and the professional." Technical Report 17, Center for Creative Leadership, 1981.

Menzel, H. "Information needs and uses in science and technology." In C. Cuadra (Ed.), Annual Review of Information Science and Technology, New York: Wiley, 1966.

Minzberg, H. The Nature of Managerial Work. New York: Harper and Row, 1973.

Organ, D. and Greene, C. "The boundary relevance of the project manager's job." R & D Management, 1972, 3, 7-11.

Pelz, D. C. "Influence: A key to effective leadership in the first-line supervisor." Personnel, 1952, 29, 3-11.

Pelz, A. and Andrews, F. M. Scientists in Organizations. New York: Wiley, 1966.

Pondy, L. "Leadership is a language game." In M. McCall and M. Lombardo (Eds.), Leadership: Where Else Can We Go? Durham, N.C.: Duke University Press, 1978.

Porter, L. and Steers, R. "Organizational, work and personal factors in employee turnover and absenteeism." Psychological Bulletin, 1973, 80, 151-176.

Ritti, R. The Engineer in the Industrial Corporation. New York: Columbia University Press, 1971.

- Rosen, N., Billings, R., Turney, J. "The emergence and allocation of leadership resources over time in a technical organization." Academy of Management Journal, 1976, 19, 165-183.
- Rosenbloom, R., and Wolek, F. Technology and Information Transfer. Boston: Harvard Business School, 1970.
- Schein, E. Career Dynamics: Matching Individual and Organizational Needs. Reading, MA: Addison-Wesley, 1978.
- Thompson, P. H., and Dalton, G. W. "Are R & D organizations obsolete?" Harvard Business Review, 1976, 54, 105-116.
- Schwartz, D., and Jacobson, E. "Organizational communication network analysis: The liaison role." Organizational Behavior and Human Performance, 1977, 18, 158-174.
- Tushman, M. "Communication across organizational boundaries: Special boundary roles in the innovation process." Administrative Science Quarterly, 1977, 22, 587-605.
- Tushman, M., and Katz, R. "External communication and project performance: An investigation into the role of gatekeepers." Management Science, 1980, 26, 1071-1085.
- Tushman, M. and Nadler, D. "Communication and technical roles in R & D laboratories." In B. Dean and J. Goldhar (Eds.), Management of Research and Innovation. New York: TIMS, North Holland Publishing Co., 1981.
- Tushman, M. and Romanelli, E. "Uncertainty, social location and influence in decision making: A sociometric analysis." Graduate School of Business, Columbia University Working Paper, 1981.
- Tushman, M., and Scanlan, T. "Characteristics and external orientations of boundary spanning individuals." Academy of Management Journal, 1981a, 24, 83-98.
- Tushman, M., and Scanlan, T. "Boundary spanning individuals: Their role in information transfer and their antecedents." Academy of Management Journal, 1981b, 24, 289-305.
- Utterback, J. "Innovation in industry and the diffusion of technology." Science, 1974, 183, 620-626.
- Vicino, F. L., and Bass, B. M. "Lifespace variables and managerial success." Journal of Applied Psychology, 1978, 63, 81-88.
- Van Maanen, J. "Experiencing organizations: Notes on the meaning of career and socialization." In J. Van Maanen (Ed.), Organizational Careers: Some New Perspectives, London: Wiley, 1977.
- Von Hippel, E. "A customer-active paradigm for industrial product idea generation." Research Policy, 1978, 7, 241-266.
- Walsh, V., and Baker, A. "Project management and communication patterns in industrial research." R & D Management, 1972, 2, 103-109.



Wanous, J. Organizational Entry. Reading, MA: Addison-Wesley, 1980.

Webber, R. "Career problems of young managers." California Management Review, 1976, 18, 19-33.

Whitley, R., and Frost, P. "Task type and information transfer in a government research lab." Human Relations, 1973, 25, 537-550.



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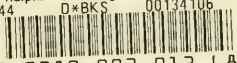


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